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TABLES

FOR

QUALITATIVE ANALYSIS.

TO ACCOMPANY

CONINGTON'S HANDBOOK OF ANALYSIS.

TABLES

FOR

QUALITATIVE ANALYSIS

TO ACCOMPANY

CONINGTON'S HANDBOOK OF ANALYSIS

SECOND EDITION

LONDON
LONGMAN, GREEN, LONGMAN, ROBERTS, & GREEN
1864

193. f. 5.

LONDON

PRINTED BY SPOTTISWOODE AND CO.

NEW-STREET SQUARE

TABLES FOR QUALITATIVE ANALYSIS.

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Table I.

I. Behaviour of Inorganic Bodies at a high tem

1. *Are readily volatile when heated on charcoal or platinum-foil, or in a dry test-tube:*	**Ammonium-, Mercury-,** some **Arsenic-,** and **Th** the air. All **organic** compounds are decomposed by
2. *Melt, without volatilising or changing colour:*	Most **Alkaline,** and some **Alkaline-earthy, salts.** Zeolites). **Borates** and **Alum** swell up: **Chlorid muth, Zinc, Tin,** are easily fusible before the blow
3. *Detonate when heated on charcoal:*	**Nitrates, Chlorates, Perchlorates, Bromates**
4. *Are infusible or difficultly fusible, and do not change colour:*	The oxides and salts of the **Earthy** and **Alkaline-ear** the earths have no alkaline reaction. **Silica** and mar **Iridium, Palladium, Rhodium,** are infusible
5. *Become of a darker colour on heating:*	**Oxides and Salts of Zinc** (with greenish-yellow i **Bismuth, Mercury** (and **Chromates**), become
6. *Colour the outer blow-pipe flame when heated on platinum-wire (if in the form of metallic salts, on charcoal):*	Yellow. **Sodium.** Violet. (bluish) **Cæsium, Potassium,** (reddish) **Rubidium.** (except the borate and phosphate). Crims **Lithium Strontiu** * Especially after moistening with hydrochloric acid or additic † Especially on addition of chloride of silver. ‡ Metallic ph
7. *Moistened with cobalt-solution, and strongly heated on charcoal, give:*	Blue Glass. Alkaline { **Phosphates, Borates, Silicates.** Blue infusible mass. **Aluminium,** and many of its compounds, **Earthy Phosphates, Silica,** and many **Silicates, Earths.** **Zinc Tita Bin Ant Niol**
8. *Heated on charcoal with carbonate of sodium (or carbonate of sodium and cyanide of potassium) in the inner flame, give:*	Garlic smell. **Most Arsenic** compounds. Alkaline Sulphide * (Selenide or Telluride). All compounds containing **Sulphur** (Selenium or Tellurium). **M** Malleable sh **Tin, Silver, Copper, Gold,** y * The mass, when moistened, stains metallic silver black, and when heated with acids evolves hydrosulphuric (hydroselenic or hydrotelluric) acid.
9. *Heated in a glass tube open at both ends, held obliquely, give:*	Gases having a peculiar smell. **Sulphides** (of burning sulphur). **Selenides** (of horse-radish). **Arsenides** (of garlic). Many **Ammoniacal** compounds (of ammonia). **Fluorides** (on addition of microcosmic salt). Metallic su Many **Arse Mercury** cc (especially tion of carl sodium).
10. *In contact with zinc, and hydrochloric (or sulphuric) acid, colour the solution:*	Violet or blue. **Titanic Acid.** Blue. **Tungstic acid** (chlorides of Tantalum and Niobium). Blue

ure, either alone, or in presence of reducing agents.

---

1 compounds: **Sulphur** and its acids: **Water**, &c. **Carbon** burns when heated in nd are generally blackened, owing to the separation of carbon.

---

retain an alkaline reaction after strong ignition in the inner flame. Many **Silicates** (*e. g.* **odium** decrepitates. **Metallic Antimony, Lead, Cadmium, Tellurium, Bis-opper, Silver, Gold,** with difficulty. The six first metals give an incrustation of oxide.

---

tes, &c.

---

etals. When ignited they become vividly incandescent, with a white light: after ignition **ates. Metallic Iron, Nickel, Cobalt, Molybdenum, Wolfram, Platinum,** ıe blowpipe.

---

ence), **Tin, Titanium, Niobium, Antimony,** become yellow: those of **Lead,**

Reddish-yellow.	Yellow-green.	Green.	Blue.
Calcium.*	**Barium,*** **Molybdenum.**	**Cupric oxide,†** **Phosphoric acid,‡** **Boric acid,‡** **Tellurous acid,** **Thallium.**	**Arsenic,** **Antimony,** **Lead,** **Selenium,** **Cupric chloride.†**

de of silver: the coloration is transitory.
ıd borates, after moistening with sulphuric acid.

---

reen mass.	Flesh-red mass.	Brown or brick-red mass.	Grey mass.
rd., } yellowish-green. **Tin,** bluish-green, nhyd., } dirty-green. d.,	**Magnesia,** **Tantalic anhyd.**	**Baryta.**	**Glucina,** **Lime,** **Strontia.**

---

ithout Incrustation.		Metal, with Incrustation.	Incrustation, without Metal.
es.	Grey infusible powder.	**Antimony,** M. brittle. Inc. white.	**Zinc,** white, not volatile, in outer flame.
	Nickel, **Cobalt,** **Iron,** **Molybdenum,** **Wolfram,** **Platinum,** **Iridium.**	**Bismuth,** M. brittle. Inc. brown-yellow. **Lead,** M. malleable. Inc. yellow. **Thallium,** M. malleable. Inc. brown.	**Cadmium,** brown-red. **Tellurium,** white.

. White sublimate.	Brown sublimate.	Fused sublimate.	Water.
Arsenides, crystalline. **Antimonides,** } fusible. **Tellurides,** } Many **Ammonium-salts.**	**Thallium-salts.**	Higher **Sulphides** (brown-yellow). **Selenides** and **Selenium** (blackish-red). **Sulphide of Arsenic.**	All **Hydrated** salts.

---

ing to green and dark-brown.	Blue, changing to dark-brown.	Green.
Molybdic acid.	**Niobous acid.**	**Chromic acid.**

Table II.

II. Behaviour of Metallic Oxides before

A clear bead is formed by fusing the flux on a loop made at the end of a platinum-wire: the bead
it is sometimes advisable to employ charcoal instead of platinum-wire. The colour of th
h. signifies hot; c. cold; supers. that the bead is supersatu

Colour of the Bead.	With Microcosmic Salt.	
	In outer or oxidising Flame.	In inner or reduci
Colourless.	*Silica* swims undissolved. *Alumina, Stannic oxide.* All *Alkaline earths,* and *Earths* (supers. opaque). *Tantalic, Niobic, Titanic, Tungstic anhydrides; Zinc-, Cadmium-, Lead-, Bismuth-, Antimonic oxides* not sat.: (supers. yellowish).	*Silica* swims undissolved. *alkaline earths* and *earths Ceric, Didymic, Manganic*
Yellow or brownish	h. not sat. *Ferric* and *Ceric oxides.* h. *Vanadic anhyd., Uranic oxide, Oxide of Silver.* c. *Nickel-oxide.*	h. *Ferric oxide* (reddish),
Red.	h. *Nickel-oxide.* h. supers. *Ferric* and *Ceric oxides.*	h. *Ferric oxide.* c. *Titan anhyd. containing iron (pric oxide.*
Violet or Amethyst.	*Manganic* and *Didymic oxides.*	c. *Titanic anhyd. Niob* sat).
Blue.	*Cobalt-oxide.* c. *Cupric oxide.*	*Cobalt-oxide. Tungstic a anhyd.* (supers.)
Green.	h. *Cupric oxide, Molybdic anhyd., Ferric oxide containing cobalt or copper.* c. *Chromic* and *Uranic oxides.*	c. *Chromic* and *Uranic* (and *Molybdic anhyd.*
Grey and Opaque.		c. *Oxides of Silver, Zinc,* (*Bismuth, Antimony: Tell*

vpipe with Microcosmic Salt and Borax.

o the finely-powdered substance under examination, and again heated. In heating in the inner flame, tly varies with its temperature, and with the quantity of oxide employed. In this table de; not sat. that it is not completely saturated with oxide.

	With Borax.	
	In outer or oxidising Flame.	In inner or reducing Flame.
All ıe). *les.*	*Silica, Alumina, Stannic oxide.*—Supers. opaque: *Alkaline earths* and *Earths, Oxide of silver, Tantalic, Niobic, Tellurous anhydrides.*—Not sat.: *Titanic, Tungstic, Molybdic anhydrides, Zinc-, Cadmium-, Lead-, Bismuth-, Antimonic oxides.*	*Silica, Alumina, Stannic oxide.*—Supers. opaque: *Alkaline earths* and *Earths, Lanthanic and Ceric oxides, Tantalic anhyd. Manganic* and *Didymic oxides.* h. *Cupric oxide.*
d.	h. *Vanadic anhyd.* h. not sat. *Ferric* and *Uranic oxides.* h. supers. *Lead-, Bismuth-,* and *Antimonic oxides.*	h. *Tungstic anhyd., Titanic, Vanadic,* and *Molybdic anhyd.* (brownish.)
ıtic *Cu-*	h. *Ceric* and *Ferric oxides.* c. *Nickel-oxide* (red-brown). h. supers. *Chromic oxide.*	c. *Cupric Oxide* (supers. opaque).
not	*Manganic* and *Didymic oxides. Nickel-oxide containing cobalt.*	
ous	*Cobalt-oxide.* c. *Cupric oxide.*	*Cobalt-oxide.*
ıdic	c. *Chromic oxide, Vanadic anhyd.* h. *Cupric oxide, Ferric oxide containing copper or cobalt.*	*Ferric, Uranic, Chromic oxides.* c. *Vanadic anhyd.*
ıad,		The same as with microcosmic salt. Also *Nickel-oxide,* and (supers.) *Niobous anhyd.*

Table III.

III. Conversion of Insoluble

When a finely powdered substance is neither dissolved by successive treatment with *water, dilute* a manner as to give an idea of the nature of the insoluble substance, it must be *rendered soluble,* many cases on the results of the preliminary examination, which must therefore be performed wit compound is finely powdered, and fused with 4 times its weight of carbonates of potassium and so contain *arsenic* or *any easily reducible metal* (antimony, tin, lead, bismuth, &c.), the fusion mus

1. Sulphates (of Barium, Strontium, Lead).	2. Silica and Silicates.	3. (I
Heated on charcoal with carbonate of sodium, they give an alkaline sulphide. *Sulphates of barium and strontium* are rendered soluble by fusion with 4 pts. alkaline carbonate. After treatment with water, the solution contains the *acid,* the residue the *base,* which is now soluble in hydrochloric acid.—*Sulphate of lead* gives a metallic globule when heated with carbonate of sodium, is blackened by sulphide of ammonium, and is soluble in basic tartrate of ammonium.—*Sulphate of calcium* is slightly soluble in water.	Swim undissolved in a bead of microcosmic salt. Those silicates which are not decomposed by hydrochloric acid are rendered soluble by fusion with 3 to 4 pts. alkaline carbonate (or hydrate of barium), treatment with hydrochloric acid, and separation of silica by evaporation with free hydrochloric acid: or by hydrofluoric acid (p. 54). In both cases the substance must be very finely powdered.	When treate evolve *hydrof* glass: if silica is evolved, w contact with w Rendered s alkaline carbo if necessary), The solution c the *bases,* whi chloric acid.
6. Binoxide of Tin, or Antimonic Anhydride.	**7. Tantalic, Tungstic, Titanic, Niobous Anhydrides.**	**8. Chlorid Silver. lybden**
Heated on charcoal with carbonate of sodium, they give a metallic globule (soft or brittle): are coloured by sulphide of ammonium. Rendered soluble by fusion with 3 to 4 pts. alkaline carbonate. Are soluble in excess of yellow sulphide of ammonium.	Give with microcosmic salt a *blue, violet,* or (in presence of iron) a *blood-red* bead; with zinc and hydrochloric acid, a *coloured* solution. Rendered soluble by fusion with 6 pts. acid sulphate of potassium (or alkaline carbonate) (pp. 106, 171).	*Chloride, b* give metallic bonate of sod treated with z *Sulphide o* with carbonat it gives sulp *molybdenum* with microcos converted into gives a blue chloric acid.

ıces into Soluble Compounds.

ıted hydrochloric or nitric acid, or aqua-regia, nor decomposed or attacked by the acids in such its constituent elements may be determined in the wet way. The method of doing this depends in case no *distinct* indication of the treatment to be adopted is obtained, according to this table, the sed mass exhausted with water, and the residue treated with hydrochloric acid. If the compound ted in a platinum crucible.

ɜs. :c.)	4. **Alumina** or **Aluminates.**	5. **Chromic Oxide.** (Chrome-iron-ore.)
t. sulphuric acid, which corrodes luoride of silicon precipitate on ion with 4 pts. ddition of silica with hot water. *:ids,* the residue oluble in hydro-	Give a *blue* infusible mass when heated with cobalt-solution. Rendered soluble by fusion with 3 to 4 pts. acid sulphate of potassium (or alkaline carbonate) and treatment with water or hydrochloric acid.	Gives a *green* bead in both flames with borax or microcosmic salt. Rendered soluble by fusion with acid sulphate of potassium, or with alkaline carbonate and nitre. Chrome-iron-ore, by successive fusion with both fluxes (p. 176).
e, Iodide of les of Mo- l, &c.	9. **Metals.** (Osmide of Iridium, or residues of Platinum-ores.)	10. **Carbon.**
iodide of silver fused with car- lime; or when sulphuric acid. metallic globule with nitric acid *Sulphide of* vish-green bead roasting it is ıhydride, which inc and hydro-	The insoluble substance has metallic lustre, or is a black powder, not affected by ignition. Rendered soluble by igniting the powder, mixed with chloride of sodium, in a stream of chlorine: or by fusion with potash and chlorate of potassium.	The insoluble substance is black (as diamond, colourless); and disappears when strongly ignited in an open platinum crucible, or before the blowpipe. Detonates when fused with nitre, forming carbonate of potassium: yields carbonic anhydride when ignited with oxide of copper.

Table IV.

IV. Behaviour of Metallic Solutions with Hydrochloric Acid, Ammonium, su

Hydrochloric Acid.	Hydrosulphuric Acid.		
Metals which are precipitated as *chlorides* from their neutral or acid solutions by *hydrochloric acid.**	Metals which are precipitated as sulphides from their hydrochloric acid solution by *hydrosulphuric acid.*		Metals whose salts are partly *reduced* in an acid solution by *hydrosulph. acid*, with separation of sulphur.*
Lead (partially), white, crystalline, soluble in much hot water, precipitated thence by sulphuric acid. **Silver**, white, curdy, soluble in ammonia, precipitated thence by nitric acid. **Mercury as subsalt**, white, finely-divided, blackened by ammonia. **Thallium as protosalt** (partially), white, crystalline, soluble in much hot water, not precipitated by sulphuric acid.	*Soluble in sulphide of ammonium.*	*Insoluble in sulphide of ammonium.*	**Iron as Ferric salt.** The solution becomes colourless, and contains a ferrous salt. **Chromium as chromate.** The solution becomes green, and contains a chromic salt.
	Arsenic (yellow). **Antimony** (orange). **Tin*** (brown or yellow). **Gold** **Platinum** (black-brown). **[Iridium]** **Molybdenum†** (brown). **[Selenium]** (red-yellow). **[Tellurium]** (black).	**Mercury*** **Silver** **Lead†** (black). **Copper** **Cadmium** (yellow). **Bismuth** (brown). **[Palladium]‡** **[Osmium]** (black-brown). **[Rhodium]** **[Ruthenium]**	
* In a saturated solution of a barium-salt, hydrochl. acid gives a white precip. readily soluble in water. In an *alkaline* solution, hydrochloric (nitric) acid gives a precipitate in presence of *Silicic* *Boric* *Antimonic* *Tungstic* acids; *Molybdic* *Benzoic* or of those metals whose oxides are soluble in alkalis (aluminium, &c., soluble in excess of acid: or of cyanides and ferrocyanides; or of those sulphides which are soluble in sulphide of ammonium. In presence of soluble polysulphides or hyposulphites, sulphur is separated.	* SnS is brown, SnS^2 yellow. From the solution of SnS in sulphide of ammonium, hydrochl. acid precipitates yellow SnS^2. † The sulphides of Wolfram and Uranium are not precip. by hydrosulph. acid from an acid solution: but they are when their solution in sulphide of ammonium is decomposed by an acid.	* Mercury as protosalt is precip. white by a little hydrosulph. acid; black by excess. † Lead is only precip. completely from dilute, not too acid, solutions. ‡ The sulphides of all the platinum-metals are precipitated very slowly.	* Sulphur is also separated in presence of free chlorine, bromine, and iodine, of *sulphurous, nitrous, hypochlorous*, chloric, iodic, *bromic* acids, &c.: and generally in presence of easily reducible salts of metals which are not precip. as sulphides from an acid solution.

The metals enclosed thus [ ] are very rare,

ısulphuric Acid, Sulphide of Ammonium, and Carbonate of ely applied.

Sulphide of Ammonium.			Carbonate of Ammonium.	
ch are precipitated by *sulphide of ammonium*, in presence of chloride of ammonium. ıtion should be neutralised with ammonia before adding sulphide of ammonium.)			Metals which are precipitated neither by *hydrosulphuric acid* nor by *sulphide of ammonium*. *Carbonate of ammonium*, in presence of chloride of ammonium,	
ohides:	*As Hydrates:* also precip. by ammonia.	*As Salts:* also prec. by amm.	*precipitates* *	*does not precip.*
} (black).	a. soluble in potash. **Aluminium** * } (colourless). **[Glucinum]** } **Chromium** (green). **[Tantalum]**†. **[Niobium]**.	a. in presence of phosphoric acid. **Magnesium** (crystalline).	**Barium** } (white). **Strontium** } **Calcium** } as carbonates.	a. precipitable by phosphate of sodium (and ammonia). **Magnesium** (crystalline).
lack-brown). (flesh-red). te).	b. insol. in potash. **[Cerium]** **[Lanthanum]** **[Didymium]** **[Yttrium]** **[Erbium]** **[Terbium]** **[Zirconium]** **[Thorium]** **[Titanium]** } generally colourless.	b. in presence of phosphoric, oxalic, boric or hydrofluoric acid. **Calcium** * } (white). **Strontium** } **Barium** } as phosphates, oxalates, borates, or fluorides.		b. not precip. by phosphate of sodium. **[Cæsium]**. **[Rubidium]**. **Potassium**. **Sodium**. **[Lithium]**.* **Ammonium**.
of nickel and icultly soluble lute hydrochl. le of nickel is ı yellow sulnium, forming n. f zinc is in- acid.	* In presence of phosphoric acid aluminium is also precip. as phosphate, sol. in potash. † Soluble after fusion with potash.	* The alkaline earthy phosphates are insol. in potash, sol. in acetic acid. Oxalate of calcium is insol. in acetic acid.	* The precipitation is not complete unless ammonia is added, and the whole heated to boiling.	* A concentrated solution of a lithium-salt is precip. by phosph. sod. on heating.

ıt be sought for except in special cases.

Table V.

V. Precipitate produced by Hydr

The solution should always be acidulated with *hydrochloric acid:* a white precip. indicates *Silver* nitric acid, it should be expelled by evaporation to dryness (latterly in water-bath); the residue then acidulated with hydrochl. acid. The precip. produced by hydrosulph. acid is thoroughly wash filtered from the residue (if any), and the filtrate mixed with hydrochl. (or dilute sulphuric) acid. it proves that sulph. amm. has dissolved something. In the latter case, the whole of the precip. by precip. formed by hydrochl. acid in the sulph. amm. solution, as in A.

A. Portion solubl

The Precipitate is *yellow* (Arsenic, Tin), or *orange-re*

Boiled with a concentrated solution of acid sulphite of potassium (*or ses*

Filtrate.

Sulphide of Arsenic (a little *sulphide of tin*).

Precipitate by dilute hydrochl. acid, dissolve the precip. in aqua-regia, and test the solution for *arsenic* in Marsh's apparatus (p. 82). (Arsenic-stains are soluble in hypochlorite of sodium, and when dissolved in nitric acid give a yellow or red-brown precip. with ammonio-nitrate of silver.) Or fuse the precip. with carbonate of sodium and cyanide of potassium, when arsenic sublimes, and *tin* remains behind in metallic state.

Sulphic

Dissolve in aqua-regia, and t
ratus. (Antimony-stains are ir
with nitric acid, give no precip.
tallic powder left in the appar
in hydrochloric acid, and chlorid
cates *tin*.

B. Portion insolubl

If the solution was acidulated with hydrochl. acid in the first instance, this residue can contain n
looked for in the

Boil with nitric acid (q

Residue may consist of:

Sulphur.	*Sulphide of Mercury.*	*Sulphate of Lead.*
Yellow or grey: collects in globules, in which sulphide of mercury may be enclosed.	Black, curdy. Dissolve in aqua-regia, concentrate by evaporation, and add chloride of tin: white or grey precip. indicates *mercury*.	White, finely-divided. Soluble in tartrate of ammonium, reprecip. by sulphuric acid.

If *mercury* be found in this residue (the solution having been originally acidulated with hydrochl. acid), it must have been as *protosalt*.

(If the s

Precipitate
Sulphate o

Soluble in t
precip. yellow l
of potassium.

ıhuric Acid in a warm acid solution.

ıry as Subsalt, Lead, or Thallium (to be examined as in Table IV.) If the solution contain free ·ed in water, and acidulated by hydrochl. acid: or the solution may be neutralised with ammonia, and a portion of it digested with sulphide of ammonium (if copper be present, with sulphide of potassium), ırecip. thus produced is *white* and *milky*, it is only *sulphur:* if it is *curdy* and more or less *coloured*, lph. acid is treated in the same manner: the residue insol. in sulph. amm. examined as in B; and the

ılphide of Ammonium.

timony).
nate of ammonium).

The Precip. is *dark-coloured.*

idue.
ıtimony and Tin.
ɔolution for *antimony* in Marsh's appa-ypochlorite of sodium, and when treated .monio-nitrate of silver.) The black me-ɛparated by levigation, washed, dissolved ːury added: a white or grey precip. indi-

It may contain also:

Sulphide of copper (traces).
„ *platinum*
„ [*iridium*]
„ *gold*
„ [*tellurium*]
„ [*selenium*]
„ *molybdenum*
„ *wolfram*
„ [*vanadium*]

detected by their behaviour to reducing agents, (chloride of tin, sulphurous acid, &c.,) and by their blowpipe reactions.

ılphide of Ammonium.

ılphide of silver nor *sub-sulphide of mercury.* Osmium, Rhodium, and Ruthenium need only be of platinum-ore.

from hydrochloric acid).

Solution may contain: *Lead, Bismuth, Copper, Cadmium.*

ɛ *brown* it probably contains *palladium*, and will give a *black* precip. with iodide of potassium.)

Add dilute sulphuric acid.

Filtrate: neutralise with ammonia.

ɑ.,
ıte

Precipitate (*white*) *Hydrate of Bismuth.*

Its solution in as little hydrochl. acid as possible is precip. by water.

Filtrate may contain:

Copper.

The solution is *blue:* and gives a *brown* precip. when acidulated, and mixed with ferrocyanide of potassium.

Cadmium:

If copper is absent, the solution is colourless, and gives a yellow precip. with hydrosulph. acid. If copper be present, add cyanide of potass. till the blue colour disappears, and then hydrosulph. acid; a yellow precip. indicates cadmium.

VI. Precipitate produced by Sulphide of Ar

If *nickel* is present, the filtrate is probably brown. The precipitate is thoroughly washed, and transfi dissolved in strong hydrochloric acid, with the addition of a little chlorate of potassium. (If *iro* ascertain whether it is present as a proto- or sesquisalt.)

Excess of potash is added to the solution,

The **Filtrate** may contain *:

Chromium, Zinc, Aluminium, Phosphate of Aluminium, [Glucinum].

Boil with hypochlorite of sodium, filter, saturate the filtrate with excess of acetic acid, and add acetate of lead.

Precipitate (yellow).
*Chromate of lead**: indicates presence of
Chromium.
Chromium is also precipitated by long boiling of the (green) potash solution.

Filtrate may contain:
Zinc,
Aluminium,
*Phosphate of Aluminium,**
[Glucinum].

Remove lead from filtrate by sulphuric acid and alcohol, add excess of *carbonate of ammonium*, and digest for some time:

Precipitate may contain:
Alumina, phosphate of aluminium.
Dissolve in nitric acid, add *molybdate of ammonium*, and heat: a *yellow* precip. indicates
Phosphoric acid.
If no phosphate be present, the precip. consists of
Alumina.

Filtrate may contain:
Zinc, [Glucinum].
Divide it into two portions. Acidulate the 1st with acetic acid, add *hydrosulph. acid:* a whitish precip. indicates
Zinc.
Boil the 2nd for some time: a precip. indicates
[Glucinum].

Cobalt, Nickel, Manganese, I Barium, Strontium, Calcium Magnesium: and *Zinc* † wit
Dissolve the

Filtrate may cont
Cobalt, Nickel, Manganese, (
Acidulate *slightly* with acetic aci sulph. acid, and hea

Precipitate:
Sulphide of cobalt,
,, nickel,
,, (zinc).
Test by blowpipe for
Cobalt.
Dissolve in hydrochl. acid, boil with excess of cyanide of potassium, add potash, *when cold*, and saturate with chlorine: formation of a *black* solution indicates
Nickel (p. 146).

Eva re w a Boil w o so **M**

* To detect traces of *aluminium* in presence of a large amount of *iron*, the sulphide of ammonium precip. is boiled at once with potash, the filtrate acidulated with hydrochl. acid, and neutralised with carb. amm.—*Chromium* may be found in the precip. or *iron* in the filtrate, according to the relative proportion of the two metals (p. 176).—If *magnesium* be present besides *chromium* or *aluminium*, it is always partially precip. by ammonia or sulphide of ammonium, as a gelatinous compound, insol. in potash: it is separated by repeated solution in hydrochl. acid, and precipitation by ammonia, in presence of excess of chloride of ammonium. The best way of separating *chromium* from *aluminium*, *iron*, and *magnesium*, is by fusion with carb. pot. and nitre (p. 176).—For separation of *phosphoric acid* from *aluminium*, see p. 61.—The precip. of *chromate of lead* should also be dissolved in nitric acid, and tested for *phosphoric acid* by molybd. amm.

† *Zinc* is not completely separated fro if *iron* be present, *zinc* is always found i and is precip. as sulphide with *cobalt* an method of separating *iron* from *zinc*, a *nickel*, and *cobalt*, is to heat the *feebly* acetate of sodium, when the *iron* (if pre pletely precipitated.—A solution cont when mixed with ammonia and chlor. manganic hydrate when exposed to th liable to be found in the ammonia-precip

um, in presence of chloride of ammonium.

the filter to a test-tube ; after subsidence, the supernatant liquor is poured off, and the precipitate nt, the original solution must be tested by sulphocyanate or ferricyanide of potassium (p. 156), to

le gently heated, and filtered when cold:

The **Precipitate** may contain:

ium, [*Uranium*, and the rare earthy metals whose hydrates are insol. in potash]: *Phosphates of nesium: Oxalate* and *Fluoride of Calcium* (also *Aluminium* and *Chromium*, with *Iron* or

ecip. in a little hydrochl. acid, and add ammonia and chloride of ammonium:

Precipitate may contain:

Iron, *Thallium*, [*Uranium*, and the rare earthy metals]; *phosphates of Barium*, *Strontium*, *Calcium*, and *Magnesium*; *oxalate* and *fluoride of Calcium*: (also *Aluminium*, *Chromium*, and *Manganese*).

Digest the precip. with a concent. solution of carbonate of ammonium: ‡

Residue may contain:

Iron, *Thallium*; *phosphates of Barium*, *Strontium*, *Calcium*, and *Magnesium*; *oxalate* and *fluoride* of *Calcium*.

Dissolve in as little hydrochl. acid as possible, and test for each constituent in a separate portion, as follows:

a. For *iron*, by sulphocyanate or ferrocyanide of potassium.

b. For *thallium*. Boil with bisulphite of sodium, and add iodide of potassium.

c. For *barium* and *strontium*, by sulphate of calcium.

d. For *magnesium*. Add acetate of sodium, and then ferric chloride till a red colour is produced, heat to boiling, filter, precipitate filtrate with carb. amm., and test with phosphate of sodium.

e. For *phosphoric acid*, by molybdate of ammonium.

f. For *oxalic acid*. Acetate of sodium precips. white oxalate of calcium, insol. in acetic acid, converted by ignition into carbonate. §

g. For *fluorine*, with the original substance, as at p. 46.

Solution may contain:

[*Uranium*.] ‖
[*Cerium*.]
[*Lanthanum*.]
[*Didymium*.]
[*Yttrium*.]
[*Thorium*.]
[*Zirconium*.] ¶

‡ This is only necessary when the presence of the rare earthy metals is suspected.

‖ If *uranium* is present, the solution, when neutralised by hydrochl. acid, gives a brown precip. with ferrocyanide of potassium. *Uranium* is also precip. by boiling the carb. amm. solution.

¶ These metals mostly form difficultly soluble double salts with potassic sulphate (pp. 167—169).

§ If *phosph. acid and iron* are present, acetate of sodium throws down a yellowish flocculent or gelatinous precip. of ferric phosphate. In this case the presence of *oxalic acid* must be proved either by igniting the precip., or as follows:— Without adding acet. sod. remove barium, strontium, and calcium by sulphuric acid and alcohol, filter, boil off alcohol from filtrate, precip. iron by ammonia, filter, and add sulphate of calcium to filtrate: a white precip., insol. in acet. acid, sol. in hydrochl. acid, indicates *oxalic acid*.

Tables VII. and VIII.

VII. Precipitate produced by Carbonate of Am

This precipitate may consist of carbonates of *barium*, *strontium*, and *calcium*. It is

Portion I.	Portion II.	
Add *sulphate of calcium*.	Add* dilute sulphuric acid in excess, filter, neutralise the filtrate with ammonia, and add oxalate of ammonium :	s Evaporate to dry and set fire to the f A
Immediate precip. indicates **Barium.** Cloudiness after a time : **Strontium.** Solution remains clear : **Calcium.**	A white precip. insol. in acetic acid, indicates **Calcium.**	t If the solution giv even after long sta time with sulphate
	* The addition of sulphuric acid is unnecessary if barium and strontium are absent.	

VIII. Metals which are not precipitated either by hy

Evaporate a moderate quantity of the solution on platinum-foil: if no residue is le
solution ir

Smaller Portion.	Larger
Add *phosphate of ammonium and free ammonia:* a white crystalline precip. indicates **Magnesium.** The precip. forms very slowly if but little magnesium is present. (If the precipitation of Group III. by carb. amm. was not effected at a boiling heat, the addition of phosph. amm. produces a slight curdy precip. of alkaline-earthy phosphate.)	a. *Magnesium is absent.* Evaporate to dryness, portion of the residue before the blowpipe: a *yellow* and lithium may also be present, and should be looked residue with a mixture of absolute ether and alcohol, v by the crimson flame of the kindled spirit: or boil a sodium, when the formation of a difficultly soluble salt water and add bichloride of platinum and alcohol; a *yell* Confirm with acid tartrate of sodium, and distinguish b b. *Magnesium is present.* Evap. to dryness and e in water, and add baryta-water to distinct alkaline r filtrate by carb. amm. and ammonia, filter, evap. filtrat proceed as in (a).—Or the magnesium may be remove acid by chloride of barium, and of barium by sulphuric test fixed residue, if any, for *potassium* and *sodium* with the rest of the filtrate, as in (a).

.n presence of chloride of ammonium and free ammonia.

solved off the filter in as little hydrochloric acid as possible, and the solution divided into 3 portions.

II.	Remarks.
esent. residue in alcohol, filter, idicates *sent.* th sulphate of strontium, es a cloudiness after a *tium* is present.	If the original solution contains no metals of Groups I. and II. it may be treated at once according to this table, without precipitating by carb. amm.: for the presence of magnesium and the alkaline metals interferes with none of these reactions, except that of Portion III. a. *Barium* is best detected in presence of *strontium* and *calcium* by means of sulphate of strontium, which gives a white precip. with barium-salts. If only a trace of barium be present, the precip. does not form at once. Barium is *separated* from strontium by fluosilicic acid, alcohol being added, in which fluosilicate of barium is quite insoluble.

IV.

.ric acid, sulphide of ammonium, or carbonate of ammonium.

the solution need not be further examined, except for ammonia: if a residue is left, divide the ne much larger than the other.

	Ammonium.
y, to expel ammoniacal salts. Test a er flame indicates **Sodium**: Potassium pe flame through blue glass. Digest the *hloride of lithium* only, to be detected sidue with carbonate and phosphate of m. Dissolve the rest of the residue in ates **Cæsium, Rubidium,** or **Potassium.** by means of the spectroscope. l salts by ignition: dissolve the residue r. Remove excess of baryta from the . ignite. If any fixed residue remains, of ammonium, the excess of phosphoric ap. a portion of filtrate to dryness, and with and without blue glass. Confirm	Ammonia must always be tested for in *a fresh portion of the original solution,* by heating it in a test-tube with *lime* or *potash.* The characteristic smell, or the formation of white fumes when a glass-rod moistened with dilute hydrochl. acid is held to the mouth of the tube, indicates **Ammonia.**

Table IX.

IX. Behaviour of the most important acids

A small portion of the dry substance is heated in a test-tube (not to boiling), with three or
decomposition, or which are decomposed by sulphuric acid at a high temperature, gas

Acids which are not volatile or decomposed.

No gas or vapour is evolved. No blackening of the mixture.

Silicic, separated by evaporation with hydrochl. acid, and identified by fusion with microcosmic salt before blowpipe.

Boric, colours alcohol-flame green, after addition of sulphuric acid.

Phosphoric, detected in neutral solutions by a magnesium-salt, chloride of ammonium, and ammonia; in acid solutions by molybdate of ammonium, or ferric chloride and acetate of sodium.

Sulphuric, barium-salt insol. in acids; sulphates yield alkaline sulphides when heated on charcoal with carbonate of sodium.

†**Arsenic**, like *phosphoric*; garlic-smell when heated on charcoal with carbonate of sodium.

†**Selenic**, barium-salt decomposed by boiling with strong hydrochl. acid. Selenates yield selenides when heated on charcoal with carbonate of sodium.

†**Tungstic**, detected by blowpipe; gives *blue* colour with zinc and hydrochl. acid.

†**Molybdic**, detected by blowpipe; gives *blue* colour, changing to *brown*, with zinc and hydrochl. acid.

†**Titanic**, detected by blowpipe; *violet* colour with zinc and hydrochl. acid.

Iodic, violet vapours on addition of ferrous sulphate; iodates detonate when heated with charcoal.

† These weak acids will have been detected in the examination for metals.

A *coloured* gas is evolved. No blackening of the mixture.

†**Hydriodic**, violet vapours, which colour starch-paste blue; black precip. with nitrate of palladium.

†**Hydrobromic**, red vapours, which colour starch-paste orange.

Bromic, the same. Bromates detonate when heated on charcoal.

Chloric, greenish-yellow explosive gas. Chlorates detonate when heated on charcoal.

Hypochlorous, chlorine evolved, which decolorises indigo-solution.

Nitrous, red vapours, even with dilute sulphuric acid.

‡ With *dilute* sulphuric acid, these acids partially volatilise undecomposed.

Acids whi

No blacke Volatile wit

Carbonic, odour

Sulphurous, s colours a solut *green*.

* **Hydrosulphu** leave *brown* p solution.

* **Hydrochloric** white fumes and with silv precip. soluble

Nitric, on additio sulphuric, red pause and indi

Acetic, acetic et alcohol.

Benzoic, neutral precip. with f

Succinic, the sa long heating.

Hydrofluoric, f glass. Metalli puric acid in a fluoride of sil precip. of silic red maintained behave in the fluoride of sil tinum crucible

* If a mixture of salts the reactions given in this table are often modified. Thus a chloride, in presence of chloride and manganese, nitrate, chloride, or the like, evolves hydrochl.

ting their salts with concentrated sulphuric acid.

its volume of concentrated sulphuric acid. In the case of all acids which are either volatile without s are evolved, the properties of which, in most cases, indicate the nature of the acids present.*

olatile, or yield volatile products of decomposition.

The vapours or gases evolved are *colourless*.

he mixture. omposition.	Decomposed by ignition. Without separation of carbon.	With separation of carbon.
tates lime-water. rning sulphur; ate of potassium	**Oxalic**, evolves carbonic anhydride and carbonic oxide: its calcium-salt is insol. in acetic acid.	*Non-volatile organic acids.* The salts of all these acids blacken when heated with strong sulphuric acid, and evolve carbonic and sulphurous anhydrides, and carbonic oxide.
eristic smell: co- med with a lead-	§**Formic**, evolves pure carbonic oxide, which burns with blue flame.	**Tartaric**, smell of burnt sugar. Its acid potassium-salt is difficultly sol. in water: its calcium-salt is sol. in cold potash, or sal-ammoniac.
gas, which gives with ammonia; a white curdy a.	§**Hydrocyanic**, evolves carbonic oxide and ammonia.	**Racemic**, calcium-salt insol. in sal-ammoniac.
filings, or ferrous h colour starch- ium *blue*.	**Cyanic**, evolves carbonic anhyd., together with some undecomposed cyanic acid, which irritates the eyes.	**Citric**, with excess of lime-water, gives a precip. *on boiling*, which redissolves on cooling.
l on addition of	**Sulphocyanic**, same as hydrocyanic, with separation of sulphur.	**Malic**, no precip. with lime-water, either hot or cold.
ive light brown e. t blackening on	**Chromic**, evolves oxygen; the solution becomes brown or green. *Green* bead with microcosmic salt.	**Tannic**, a white viscous precip. with gelatine: a blue-black precip. with ferric salts.
which corrodes heated with sul- l, evolve gaseous gives a white ct with a glass- *Fluosilicates* r: they evolve eated in a pla- uric acid.	**Hyposulphurous**, evolves sulphurous anhydride and separates sulphur. Its alkaline salts are converted into sulphides by heat. The other *polythionic acids* behave in the same way.	**Gallic**, no precip. with gelatine: a dark-blue precip. with ferric salts.
		Uric, after evaporation with nitric acid, a purple colour with ammonia.

§ With *dilute* sulphuric acid, these acids volatilise undecomposed, at least partially. Ferro- and ferricyanides behave like cyanides: they are detected in solutions by their reactions with ferric and ferrous salts.

te, evolves chlorine and red nitrous fumes: in presence of a *chromate*, red fumes of chlorochromic acid (p. 98), &c. rong sulphuric acid. *Sulphides* often evolve sulphurous anhydride, and separate sulphur.

Table X.

X. Behaviour of the most important

A. *Examination for acids in soluble compounds.*—With an aqueous solution the first step is to neutral or slightly alkaline solution, it is generally necessary to begin by removing all the metals contai alkaline-earthy *oxalates, phosphates,* &c. will be detected. The nature of the metals found will often i not be looked for in a solution containing *barium*, nor *hydrochloric acid* in a solution containing *silver.* see below. When an acid has been *added* (for neutralisation or solution) of course it is impossible to te sometimes necessary, instead of the reagent indicated in the Table, to use the *nitrate* of the same ba solutions containing lead or silver. These remarks apply also to Table XI., which is a continuation of thi

Hydrochloric or Nitric Acid precipitates:	Chloride (or Nitrate) of Barium precipitates:	Chlor
from a neutral or slightly alkaline solution.	from a solution acidulated with nitric or hydrochloric acid.	from a neutral soluti (precip. is sol. in amt
Silicic, gelatinous: in dilute solutions only after evaporation: precip. also by chloride or carbonate of ammonium.	**Sulphuric**, white, finely divided. (If too much free acid be present, chloride or nitrate of barium may be precip.: sol. on adding water.) The precip. yields an alkaline sulphide when heated on charcoal with carb. sod.	**Phosphoric**, white, sol. acid when freshly pre
Boric, crystalline: from concentrated solutions only: green alcohol-flame on addition of sulphuric acid.	**Selenic**, the same. The precip. heated with strong hydrochl. acid evolves chlorine, and sulphurous acid precips. red selenium from the solution: heated on charcoal with carb. sod. it gives a smell of horseradish.	**Arsenic**, the same, sol. ride of amm. The a solution is precip. b sulph. acid.
Antimonic, white, sol. in tartaric acid.	**Fluosilicic**, gelatinous, hardly visible: decomposed by strong acids. The precip. heated alone yields fluoride of silicon and fluoride of barium: with alkalis, silica and metallic fluorides.	**Boric**, white, sol. in al not precip. from dilute Turmeric-paper dipp solution of the preci drochl. acid is brow drying.
Tungstic, white, yellow on boiling: blue colour with zinc and hydrochl. acid.	from neutral solutions (precip. being sol. in acids):	**Carbonic**, white, sol. with effervescence.
Molybdic, white, sol. in excess of acid: blue colour with zinc and hydrochl. acid: yellow precip. with phosphate of ammonium.	**Sulphurous**, **Phosphoric**, **Carbonic**, **Silicic**, **Hydrofluoric**, **Oxalic**, **Boric**, **Tartaric**, **Citric**, **Arsenic**, **Arsenious**, (not if amm. salts are present.) white.	**Sulphurous**, white, dilute solutions. On of chlorine-water to solution of the precip. of calcium is precip.*
Sulphur, white or yellowish: from *hyposulphites* with evolution of sulphurous anhydride: from *polysulphides*, of hydrosulphuric acid.	**Chromic**, yellow.	**Tartaric**, white, sol. amm. or potash: the solution is precip. by b
Iodine, black precip. or brown coloration: from a solution of an iodide containing iodate.		**Citric**, white, not until ammonia or lime-water and the whole boiled.
From an alkaline solution may also be precip. *oxides* and *sulphides* which are sol. in potash, and *cyanides* and *chlorides* which are soluble in cyanide of potassium. If the alkaline solution be saturated with hydrosulphuric acid, hydrochl. acid precipitates as *sulphides* those metallic acids which form insol. sulphides.		**Ferrocyanides** are pre slowly: yellowish, di sol. in acetic acid.
Of *organic acids*, *benzoic*, *uric*, and *tartaric* (as acid tartrate of potassium) are *precip.* by acids from alkaline solutions.		

* This reaction is much mor with chloride of barium.

acids with reagents in the wet way.

est with litmus-paper whether it is *acid, neutral,* or *alkaline.* As many acids must be sought for in a d in the solution, except the alkaline metals, by Table IV.: in which process the metallic acids and nply the absence of one or more acids, so that they need not be looked for: thus *sulphuric acid* need

This is invariably true only in *neutral* or *acid* solutions: in *alkaline* solutions there are exceptions: for that acid in the solution: a fresh portion of the substance under examination must be taken. It is (since nitric acid forms no insoluble salts): *e.g.* nitrate must be substituted for chloride of barium for table.

ide of Calcium precipitates:		Sulphate (or Chloride) of Magnesium precipitates:
on only ic acid).	from a neutral or acetic acid solution (precip. is insol. in acetic acid).	in presence of chloride of ammonium and free ammonia.
in acetic ip.	**Oxalic**, white, insol. in chlor. amm.: after ignition effervesces with acids. Sulphate of calcium gives the precip.	**Phosphoric**, white, crystalline, sol. in all acids: forms slowly in dilute solutions.
in chlo- idulated hydro-	**Racemic**, white, insol. in chlor. amm. Sulphate of calcium gives the precip. after a time.	**Arsenic**, the same. The acidulated solution is precip. by hydrosulph acid.
or. amm. olutions. in the in hy- n after	**Hydrofluoric**, gelatinous: with strong sulphuric acid the precip. evolves hydrofluoric acid, which corrodes glass.	**Tartaric**, white, forms slowly: only from concent. solutions. The precip. blackens on ignition.
in acids	**Sulphuric**, white: not from dilute solutions: completely on addition of alcohol.	
ot from addition the acid sulphate	Separation of Oxalic, Tartaric, Citric, and Malic Acids.	
	Add chloride of calcium and lime-water to alkaline reaction.	
n chlor. potash oiling.	Precipitate. *Oxalate, Tartrate* of calcium.	Filtrate. *Citrate, Malate* of calcium.
xcess of is added	Digest with cold potash.	Heat to boiling.
	Residue.	Filtrate.
ipitated fficultly	*Oxalate* of calc. Insol. in acetic acid or chloride of copper · sol. in hydrochl. acid.	*Tartrate* of calc. Precipitated gelatinous on boiling the alkaline solution, redissolved on cooling.
e delicate		
	Precipitate.	Filtrate.
	Citrate of calc. Sol. in chloride of copper.	*Malate* of calc. Precipitated by addition of alcohol after evaporation.

Table XI.

XI. Behaviour of the most important acids

Sesquichloride of Iron		
Gives a precipitate.	Gives a coloration.	From a *neutral* s
a. *In presence of free hydrochl. acid.*	a. *In presence of free hydrochl. acid.*	*The precip. is sol.* i *acid*
Ferrocyanides, deep-blue: the precip. is decomposed by potash into ferric hydrate and ferrocyanide of potassium.	**Ferricyanides,** brown. Ferrous salts give deep-blue precip.	**Phosphoric,** yellow molybdate of amm
b. *In a solution which is neutral, or contains free acetic acid* (obtained by adding acetate of sodium to the hydrochl. acid solution).	**Sulphocyanic,** blood-red: destroyed by chloride of mercury, not by hydrochl. acid.	**Arsenic,** red-brown low. Original aci by hydrosulph. ac
Phosphoric, yellowish-white: insoluble in acetic acid, sol. in hydrochl. acid or ferric acetate.	b. *In neutral solutions only.* (The colour is destroyed by hydrochl. acid.)	**Chromic,** red. The or red solution bc sulphurous acid.
Arsenic, the same: acid solution precip. by hydrosulph. acid.	**Acetic,** red-brown. The original compound, heated with sulphuric acid and alcohol, forms acetic ether.	**Oxalic,** white: ins The calcium-salt acetic acid.
Tannic, black-blue. The original solution is precip. by gelatine.	**Formic,** the same. The original compound reduces silver- and mercuric salts, with evolution of carbonic anhyd.	**Boric,** white: solu green alcohol-flam
c. *In a neutral solution only.*	**Sulphurous,** the same. The colour disappears on boiling, without a precip. The original compound evolves sulphurous anhyd. when treated with hydrochl. acid.	**Tartaric,** white: s duced on boiling.
Boric, yellowish: its hydrochl. acid solution colours turmeric-paper brown.	**Meconic,** blood-red; not changed by chloride of gold.	**Citric,** white.
Benzoic, light-brown: hydrochl. acid gives a white crystalline precip. in the original concent. solution.	**Gallic,** black. The original solution is not precip. by gelatine.	**Silicic,** yellow, from
Succinic, the same. The concent. solution of the ammonium-salt (obtained by digesting the ferric salt in ammonia), is precip. by chloride of barium, in presence of alcohol and free ammonia (distinction fr. *benzoic.*)		All these precipa monia. *Pyro-* and acids are precip. w after addition of ace by albumen. A ce an *acetate* is pre silver, crystalline.
		Sulphurous and H white precips., an duce metallic silve

B. *Examination for acids in compounds which are insol. in water or acids.*—The nature of Tables I. II. and IX. *Inorganic* compounds (those which do not blacken when heated) are decompos sodium, and extracting the fused mass with water: the aqueous solution contains the acids, and is neutrali *the heavy metals* may be decomposed by digestion in sulphide of ammonium, alkaline-earthy sulphates by *treated with nitric acid* or aqua-regia, form *sulphuric acid.* Insoluble salts of *organic* acids are decom *ammonia: the filtrate contains* the alkaline salt of the acid, and is examined by Tables X. and XI.

with reagents in the wet way (continued).

Nitrate of Silver precipitates		Indigo-solution is decolorised by
solution only.	From an *acid* solution also.	
in dilute nitric	*The precip. is insol. in dilute nitric acid*	a. *Without addition of an acid.*
Confirm with onium.	**Hydrochloric**, white, curdy, sol. in ammonia, or hyposulphite sod.	Free **Chlorine** and **Bromine**: all the **oxygen-acids of chlorine** (free), and metallic **hypochlorites**: free **nitric acid**, if not too dilute.
Arsenious, yellow solution precip. id.	**Hydrobromic**, the same; less sol. in ammonia. The original solution colours ether yellow on addition of chlorine-water.	Also **alkaline sulphides** and **caustic alkalis.**
original yellow coloured green by	**Hydriodic**, yellow; scarcely sol. in ammonia. Original solution gives blue colour with starch and nitrous fumes.	b. *On addition of an acid (hydrochl. or sulphuric) and heating.*
sol. in acetic acid. is also insol. in	**Iodic**, white; sol. in ammonia, whence sulphurous acid. precips. iodide of silver. Original solution, in presence of an iodide, gives blue colour with starch and acetic acid.	**Chlorates**, converted into chlorides by ignition.
ble in acetic acid: e.	**Hydrocyanic**, white, curdy; sol. in ammonia, hyposulphite sod., and cyanide potass. Original solution gives Prussian blue with ferroso-ferric salts, potash, and hydrochl. acid.	**Nitrates**, brown colour with ferrous sulphate and sulphuric acid.
metallic silver re-	**Ferrocyanides**, white; insol. in ammonia. Original solution gives dark-blue precip. with ferric salts.	**Iodates**, the dry salt gives violet fumes with ferrous sulphate and sulphuric acid.
a concent. solution.	**Ferricyanides**, red-brown. Original solution gives dark-blue precip. with ferrous salts.	**Bromates**, give red bromine-vapours with sulphuric acid.
are soluble in am- *metaphosphoric* hite: the latter, tic acid, is precip. ncent. solution of ip. by nitrate of	**Sulphocyanic**, white; difficultly sol. in ammonia. Original solution is coloured red by ferric chloride.	c. *Evolve chlorine (and so bleach indigo) when heated with concentrated hydrochl. acid.*
ormic acids give d on heating re- r.	**Hydrosulphuric**, black; insol. in ammonia: lead and copper-salts give black precip. Alkaline sulphides give purple colour with nitroprusside of sodium.	All the foregoing compounds: also **Chromates.** **Selenates.** **Tellurates.** **Manganates** and **Permanganates.** All **Peroxides.**

the compound, and the acids probably present, are ascertained by a preliminary examination by ed by fusing them, finely powdered, with four times their weight of *pure* carbonates of potassium and ised with hydrochl., nitric, or acetic acid, and examined by Tables X. and XI. Insoluble compounds of boiling with a concent. solution of carbonate of sodium: the filtrate contains the acid. Sulphides, when nposed by boiling with an alkaline carbonate; ferric salts of volatile organic acids by digestion with

Table XII.

XII. Behaviour of na

Natural silicates behave very variously, when finely powdered and treated with mineral acids. Som majority separate silica in the *gelatinous* form: others (which are generally decomposed with greate when evaporated, deposits gelatinous silica. Some (*e. g.* most zeolites) are less readily acted on by which acts most generally on silicates is sulphuric acid: but hydrochloric acid is the most convenie resist the action of acids are decomposed by fusion with 3—4 pts. carbonates of potassium and sodiun The minerals marl

Decomposed by acids.

(a.) *Completely sol. in dilute acids.*

Allophane.
Collyrite.
Z. Gismondine; zeagonite.
Kielhauite; yttrotitanite.

(o.) *Separate gelatinous silica.*

Z. Aedelforsite.
Allanite; orthite; cerin.
Z. Analcime.
Z. Apophyllite.

Barsowite.
s. Biotite; uniaxial or magnesia-mica.
Bismuth-blende; eulytine.

Cancrinite; davine.
Cerite.
Z. Chabasite; levyne.
Chamoisite.
Chondrodite.
Cronstedtite.

Datolite; botryolite.
Diaptase.

Eudialite.

Gadolinite (bef. ig.)
Galmei; willemite.
Gehlenite.
Z. Gmelinite; sarcolite; hydrolite.

s. Halloysite; lenzinite; tuesite.
Haüyne; lasurstein; nosean.
Helvine.
Z. *Heulandtite.*

Hisingerite; thraulite.
Humboldtilite; melilite.

Z. Ittnerite.

Knebelite.

Z. Laumonite.
Lievrite; ilvaite.

Meerschaum.
Meionite.
Z. Mesotype; mesole; mesolite; natrolite; poonahlite; scolezite.

Nepheline; elaeolite.
Nontronite.

Z. Okenite; dysklasite.
s. Olivine; chrysolite; peridot; hyalosiderite.

Z. Pectolite.
Z. Potash-harmotome; phillipsite.

Schrötterite.
Z. Sideroschisolite.
Sodalite.
Spadaite.
Z. Stilbite; desmine.

Tcheffkinite.
Z. Thomsonite; comptonite.
Thorite.

Wolchonskoite.
Wollastonite; table-spar.

(c.) *Gelatinise after ignition.*

Axinite.
Epidot; pistazite; zoisite.
Garnet; pyrope.
Idocrase; vesuvian.

Lepidolite.
Z. Prehnite.
s. Tourmaline.

(d.) *Separate pulverul silica.*

Amphodelite.
Anorthite.
Antigorite (flocculent).
Z. Baryta-harmotome; stone.
Chonicrite; vermiculite
Chrysocolla.
s. Damourite (pearly scale
Z. Epistilbite (bef. ig.)
Lepidomelan (pearly sc
Leucite.

Pennine.
Pinguite.
Pollux.
Pyrosklerite.

Ryacolite.

(e.) *Separate silica in o the above forms.*

hot s. Agalmatolite.
Anthosiderite.
Z. Brewsterite.
s. Chlorite; ripidolite.
Clintonite.
Z. Faujasite.

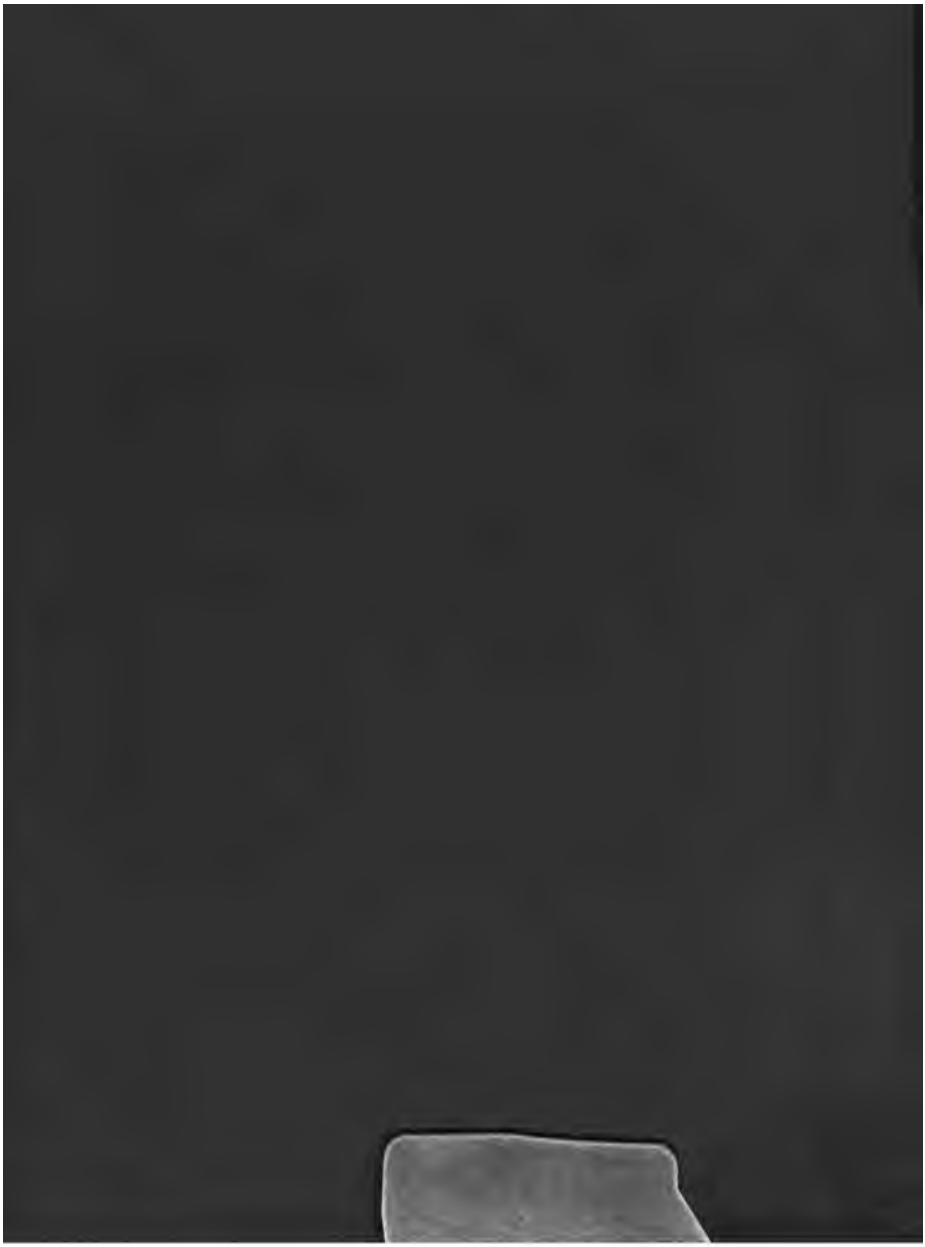
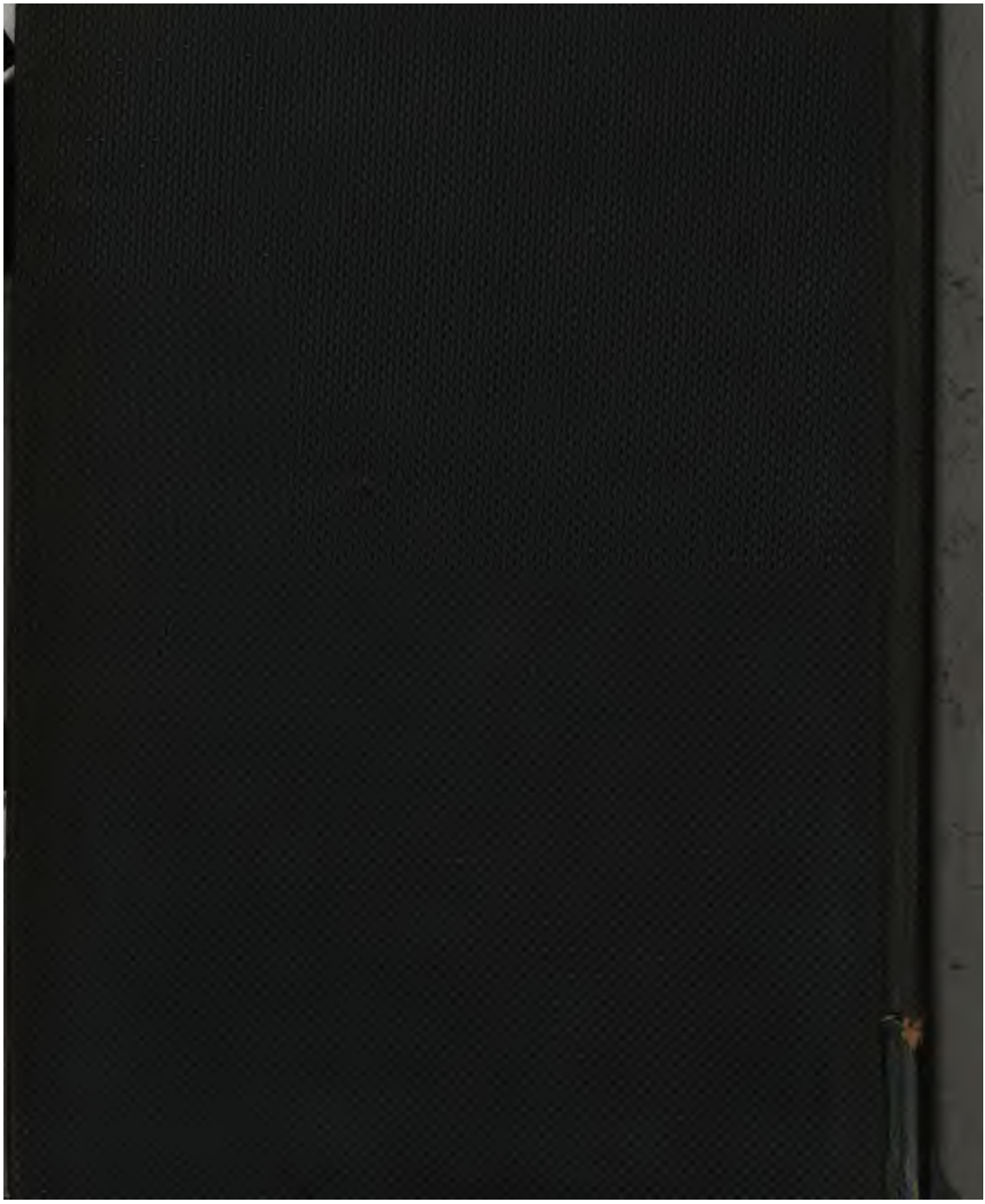
Labradorite.

Margarite.
s. Onkosine.
n. hot s. Ottrelite.

.tes to acids.

ırtially decomposed: while others resist the action of acids altogether. Of the former class, the ate it in the form of a *powder:* a few are completely soluble in dilute acids, and the solution, ɔn: others, which resist acids before ignition, are decomposed by acids after ignition. The acid lication (p. 53). In this table, s. signifies sulphuric, and n. nitric, acid.—Those silicates which f alkaline silicates, by carbonate or hydrate of barium: or by hydrofluoric acid (p. 54). eolite family.

	Not decomposed by acids.	
ɔnite. ain-spar. gillite. ılore. nalite.	Albite; soda-felspar. * Andalusite; chiastolite. Augite; diallage; diopside; hypersthene.	Jeffersonite. Kaolin. Karpholite.
lite; wernerite; dipyre. ɛr-spar. ıtine. one. e; titanite.	Beryl; davidsonite. Castor. Chloritoid; chlorite-spar. Couzeranite. * Cyanite; disthene; buchol-zite. * Cymophane; chrysoberyl.	Oligoclase; soda-spodumen. Paragonite; mica-slate. Pericline; potash-albite. Petalite. Phenakite. Pinite. Pitchstone; obsidian; pumice. Potash-mica (biaxial).
lite. ite. erite.	Emerald. Euclase. Fahlunite; triclasite. Felspar; orthoclase. Gedrite. Green-earth.	Saussurite. * Sillimanite. Spodumen; triphane. * Staurolite. Talc; speckstein. Topaz; pycnite; pyrophy-salite.
rtially decomposed. e. . hite. fuller's earth. pal. erite; dichroite; iolite. tonite. phane. . hin. lite; clinkstone. hyllite. walite. omelan. *w*-earth.	Hornblende; anthophyllite; asbestos; grammatite; tremolite; uralite. Hypochlorite; green-ironstone.	Wichtyn; wichtyzite. Wörthite. * Zircon; hyacinth.
ery imperfectly.		

* Are decomposed with difficulty by fusion with alkaline carbonates, or by hydrofluoric acid (p. 54).

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